



Assessing the need for a feminist foreign policy in Ecuador through a sentiment analysis based on neutroAlgebra

Daniela Cecilia Márquez Carriel¹, Luis Oña Garces², Arnaldo Vergara Romero³, and Fidel Márquez Sanchez⁴

¹ ECOTEC University, Guayaquil. Samborondon. Ecuador. E-mail: danielacmarquezc@outlook.com

² ECOTEC University, Guayaquil. Samborondon. Ecuador. E-mail: luis.onagarces@gmail.com

³ Bolivarian University of Ecuador, Duran. Samborondon. Ecuador. E-mail: avergarar@ube.edu.ec

⁴ Espiritu Santo University, Samborondón. Ecuador. E-mail: fmarquez@uees.edu.ec

Abstract. This paper examines the potential for a feminist foreign policy in Ecuador, a concept gaining global attention but still new in local debates. While Ecuador's foreign policy has historically focused on economic and strategic interests, the rising influence of feminist movements is prompting discussions about integrating gender perspectives into diplomacy, trade, and international aid. Using neutrosophic sentiment analysis, the study finds divided opinions: while "Gender Equality" and "Human Rights" receive stable support, the "Economic Impact" variable shows significant uncertainty. Some view a feminist foreign policy as a way to enhance Ecuador's global standing and gender equity, while others are skeptical of its feasibility in the current political and social climate. The study calls for more research to understand public and political perceptions, particularly on the economic impacts and how such a policy could be adapted to Ecuador's specific needs.

Keywords: Foreign Policy, Feminist, Neutroalgebra, Prospector, Sentiment Analysis.

1 Introduction

The topic of feminist foreign policy [1] has been gaining strength in global discussions and, little by little, has crept into local debates. Ecuador is no exception. This research delves into an area that may seem novel but touches deep fibers about how the country relates to the world and how international policies reflect or do not, gender equity values. Some authors have pointed out that feminist foreign policies seek to integrate the gender perspective in matters such as diplomacy, trade, and international aid [2, 3]. However, in Ecuador, the question is not only whether we need a feminist foreign policy, but how it could adapt to our realities.

Historically, Ecuador's foreign policy has been marked by economic interests, strategic alliances, and, to a lesser extent, human rights [4]. Few imagined, just a few years ago, that one could talk about diplomacy from a gender perspective. But today, with the growing visibility of feminist movements and demands for greater equality of rights, the possibility of foreign policy also reflecting these struggles has begun to be discussed. Cases such as Sweden, which became the first country to officially adopt a feminist foreign policy in 2014, have served as inspiration, although not without criticism [3]. But of course, replicating this model in a country with such different realities as Ecuador is not so simple.

Now, the main question driving this research is: Is a feminist foreign policy viable and necessary in Ecuador? It seems like a simple question, but when exploring it, layers of complexity emerge. It is not just about adding the term "feminist" to foreign policy; it is about understanding what that means in a context where gender inequality remains a latent problem and where national interests do not always align with human rights agendas [4]. In addition, it must be considered that any change in foreign policy could have implications both for the country's international image and its strategic positioning. Could, then, a feminist policy contribute something more than just a discourse? The gap in current literature on the subject is notable. While there are studies on feminist foreign policies in Europe and North America, in Latin America, and particularly in Ecuador, the lack of research is evident [5].

This could be due, in part, to the fact that foreign policy has traditionally been a field dominated by more conservative visions, where gender issues are not a priority. Furthermore, how citizen perception of this idea influences its possible implementation has not been sufficiently explored. This is where our neutrosophic approach comes into play: capturing those perceptions that are often contradictory or indefinite. To address this complexity, this study employs sentiment analysis based on neutroAlgebra [6], a tool that allows for dealing with the indeterminacy and ambiguity inherent in human opinions [7, 8]. This approach not only examines the arguments for and against a feminist foreign policy but also unravels those grey areas, those opinions that do not align neatly into a “yes” or “no”. The methodology includes qualitative and quantitative data collection, combining sentiment analysis techniques with the mathematical structure of neutroAlgebra to assess the need for a feminist foreign policy.

Preliminary results suggest that perceptions about the need for a feminist foreign policy in Ecuador are divided, with a strong presence of indeterminate opinions reflecting both skepticism and cautious support [9, 10]. While some see the possibility of improving Ecuador’s representation in international forums through a gender lens, others doubt its viability, especially in a political and social context that is not always receptive to changes in traditional norms. This finding is key, as it highlights the need for a deeper analysis that goes beyond the obvious. In conclusion, the objectives of this study are clear: to assess the viability of a feminist foreign policy in Ecuador through a sentiment analysis based on neutral algebra and to provide a balanced view of its potential benefits and limitations. This approach seeks not only to fill an academic gap but also to offer a practical tool for policymakers who wish to better understand how the population perceives these issues. In doing so, it is hoped to contribute to a more informed and less polarized debate on the future direction of Ecuadorian foreign policy.

2 Preliminaries

2.2 Sentiment analysis

Sentiment analysis, at its core, relies on the use of natural language processing tools, combined with text analysis and computational linguistics techniques, to unravel the subjective part hidden in various sources of information [8]. In the field of text mining, this approach stands out for its ability to mass classify the polarity of data, that is, to determine whether something is positive, negative, or neutral.

Given a corpus T containing a set of texts, the goal of sentiment analysis is to assign a **polarity score** to each text element $t_i \in T$. This score reflects whether the sentiment of the text is **positive**, **neutral**, or **negative** [11]

The sentiment scores are typically derived from [12]:

- Lexicon-based models: Predefined lists of words or phrases with associated positive, negative, or neutral scores.
- Machine learning models: Trained classifiers that output probabilities for each sentiment category.

Using neutroAlgebra [13] we can extend the sentiment classification by introducing the concept of $I(T_i)$. This accounts for uncertainty or ambiguity in the sentiment of the text using the symbol I . The sentiment analysis function becomes:

$$S_{neut}(t_i) = (P(t_i), N(t_i), U(t_i), I(t_i)) \quad (1)$$

Where:

$P(t_i)$, represents the **positive** sentiment score in the text

$N(t_i)$, represents the **negative** sentiment score in the text

$U(t_i)$, represents the **neutral** sentiment score in the text

$I(t_i)$ represents the **indeterminate** sentiment component, reflecting uncertainty or mixed sentiment in the text.

When measuring these sentiments, experts insist that it is essential to include a neutral option, since an emotional state cannot always be labeled as simply positive or negative. Sometimes, people are somewhere in the middle, with their emotions not leaning towards one side or the other. This is where Neutrosophy comes into play, since this theory not only covers the positive and the negative but also recognizes the existence of neutral. This is especially useful when analyzing texts, because not all words have a clear connotation and many times the meaning can be ambiguous, adding extra complexity to the analysis.

a. Method

For a given natural number $n > 0$, NeuroGroup is defined from the combinator function of Prospector. Prospector is a well-known expert system [14, 15]. The set NeuroGroup consists of all integers between $-n$ and n plus the symbolic element I to represent indeterminacy. This is $NG_5 = \{-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, I\}$ and \oplus_5 is used. This is defined according to the following Cayley table:

Table 1. Cayley table corresponding to \oplus_5 . Source: [16].

\oplus_5	-5	-4	-3	-2	-1	0	I	1	2	3	4	5
-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	I
-4	-5	-5	-5	-5	-4	-4	-4	-4	-3	-2	0	5
-3	-5	-5	-4	-4	-4	-3	-3	-2	-1	0	2	5
-2	-5	-5	-4	-3	-3	-2	-2	-1	0	1	3	5
-1	-5	-4	-4	-3	-2	-1	-1	0	1	2	4	5
0	-5	-4	-3	-2	-1	0	I	1	2	3	4	5
I	-5	-4	-3	-2	-1	I	I	I	I	I	I	I
1	-5	-4	-2	-1	0	1	I	2	3	4	4	5
2	-5	-3	-1	0	1	2	I	3	3	4	5	5
3	-5	-2	0	1	2	3	I	4	4	4	5	5
4	-5	0	2	3	4	4	I	4	5	5	5	5
5	I	5	5	5	5	5	I	5	5	5	5	5

\oplus_5 It satisfies the properties of commutativity and associativity and has 0 as a null element. In addition, it satisfies each of the following properties:

- If $x, y < 0$ then $x \oplus_5 y \leq \min(x, y)$,
- If $x, y > 0$ then $x \oplus_5 y \geq \max(x, y)$,
- If $x < 0$ and $y > 0$ or if $x > 0$ and $y < 0$, then we have $\min(x, y) \leq x \oplus_5 y \leq \max(x, y)$.
- $\forall x \in G, x \oplus_5 0 = x$.
- $(-5) \oplus_5 5 = 5 \oplus_5 (-5) = I$.

Sentiment analysis, through the neutrosophic method, focuses on assessing integrity, transparency, and accountability within organizations. Using this theory, opinions and perceptions are examined by considering the degrees of positivity, negativity, and indeterminacy. This approach not only captures clear sentiments, such as positive and negative ones but also addresses those that are neutral or ambiguous, thus achieving a more accurate assessment and a better understanding of how these aspects are perceived in the organizational environment [17].

This method, particularly effective in the analysis of short and informal texts, as described in the technique mentioned above, requires the identification of a set of words that are classified as positive, negative or neutral, each with a strength value evaluated in a range from -5 to 5, or that are marked as indeterminate. Indeterminacy occurs when it is not possible to decipher the individual's thoughts on the subject in question, which may occur due to a lack of clarity in the semantics of the text or because the text is unintelligible. Furthermore, in certain cases, it is possible that in the same text extreme evaluations of positivity (+5) and negativity (-5) are presented for the same variable, which generates a contradiction that is classified as indeterminate, marked with the letter I. This indeterminacy can have different origins, which becomes evident when the function used in the PROSPECT expert system, which evaluates the degree of evidence of an expert on a particular aspect, finds maximum evidence but in opposite directions for two different aspects.

This method, which borrows some elements from the SentiStrength sentiment strength detection algorithm [18], allows terms related to the analyzed variables to be classified as Positive, Negative or Neutral in a list using linguistic values. Each of these terms is associated with a value between -5 and 5, or even I, depending on the intensity of its positive or negative charge. For example, the term "I like" increases its positive value if expressed as "I like it a lot", while "I don't like it" becomes more negative by saying "I don't like it a lot". What applies is that for the word "much" or "a lot" that modifies one of the positive or negative classifying words, is used $x \oplus_5 x$, and for "too much" $x \oplus_5 x \oplus_5 x$, where x is the value that is associated with the word. For example, $x > 0$ it results in "very" with an even more positive value. On the other hand, when $x < 0$, the result is more negative.

Also, the modification of "quite" is converted to $\left[\text{sig}(x) \sqrt{|x|} \right]$.

- They take into account words that reverse the meaning of what is said. In this case, the sign is changed. For example, "I like" has a value of $x = 3$, when it comes to "I don't like" it is calculated as $x = -3$, both have the same strength, but with opposite meaning.
- In this algorithm, very complex cases, where there are exclamation or question marks, are ignored, since we want to evaluate what the members of the organization or clients write, if it makes sense, about each of the twelve aspects of ethics mentioned in the previous points.
- Another aspect that is taken into account in the proposed algorithm taken from the previous one is the evaluation of the emoticons.
- Spell checking also applies here.

The next step is the evaluation of a short informal text written by a person. To do this, natural language processing is performed, where words that express feelings or opinions about each of the twelve aspects mentioned above are searched for. Let us denote these aspects as $V = \{v_1, v_2, \dots, v_{12}\}$:

Then, within the text processing, the words referring to each of these variables are identified. These words are identified with a value from -5 to 5 or I. Let us denote this as follows, for the i -th variable, the set X_i of word ratings that appear in the text:

$v_i \rightarrow X_i = \{x_{i1}, x_{i2}, \dots, x_{im_i}\}$, where x_{ij} It is the set of elements between -5 and 5 or I, used to qualify the words that refer to the i -th variable.

Note that even the individual evaluation of each word can be complicated. For example, when modifiers such as "very" appear, the value of the modified word changes. Also when there are spelling errors that make an evaluation illegible, it is necessary to use the value I. The final value associated with each v_i is:

$$x_{total,i} = x_{i1} \oplus_5 x_{i2} \oplus_5 \dots \oplus_5 x_{im_i} \quad (2)$$

Let us keep in mind that we do not consider it convenient to obtain an aggregate ethical value for all the variables since the separate value is more useful to have an idea of the individual opinion or feeling.

If we have a set of people whose opinion is being studied. Let us call this set of people by $P = \{p_1, p_2, \dots, p_l\}$, so that the values are taken into account, $x_{total,i,j}$ it is the total value of the i -th ethics variable in the organization, according to the j th person.

It is calculated:

$$\bar{x}_{total,i} = \frac{\sum_{j=1}^l x_{total,i,j}}{l} \quad (3)$$

That is, the arithmetic mean of each of the variables is calculated.

Finally, if the I symbol appears a de-neutrosophication process is developed replacing $I \in [-5, 5]$ both maximum and minimum values []

3 Case Study.

An analysis was conducted using the neutrosophic sentiment analysis method to assess the perception of the need for a feminist foreign policy in Ecuador. Opinions were collected from 12 specialists on the topic, categorized by their areas of specialization. Each specialist provided brief texts in which they assessed various variables related to the topic.

Variables Evaluated:

1. Gender Equality: his variable assesses how a feminist foreign policy would promote gender equality both domestically and internationally. It looks at whether the policy can enhance the representation of women in diplomatic roles and integrate gender equity into international treaties and political agendas.
2. Human Rights: This variable examines the impact of a feminist foreign policy on the defense and promotion of human rights, especially the rights of women and vulnerable groups. It assesses whether the policy incorporates women's rights in international negotiations and supports global human rights movements.
3. Economic Impact: This variable measures the economic consequences of implementing a feminist foreign policy. It analyzes whether the policy would have positive or negative economic implications for the country, focusing on trade agreements that favor gender equity and the cost-benefit of adopting feminist policies internationally.

Evaluation and Calculations:

The evaluations of each specialist for each variable were processed, applying the neutrosophic method of sentiment analysis. The values of each word were adjusted with modifiers and corrections, and the means for each variable were calculated.

Evaluation Data:

For each specialist, words related to the variables were identified, with assigned values ranging from -5 to 5 or I (indeterminate). Calculations were performed according to the rules of the neutrosophic method.

Table 2. Gender Equality Assessment.

Specialist	Evaluation 1	Evaluation 2	Evaluation 3	Final Result $\oplus 5$
Specialist 1	3	4	1	5
Specialist 2	4	2	1	4
Specialist 3	5	4	3	5
Specialist 4	2	3	2	3
Specialist 5	2	5	1	5
Specialist 6	3	2	4	5
Specialist 7	3	2	1	3

Specialist	Evaluation 1	Evaluation 2	Evaluation 3	Final Result \oplus_5
Specialist 8	3	2	0	4
Specialist 9	2	4	1	4
Specialist 10	5	5	2	5
Specialist 11	0	3	2	3
Specialist 12	4	2	3	5

Table 3. Human Rights Assessment.

Specialist	Evaluation 1	Evaluation 2	Evaluation 3	Final Result \oplus_5
Specialist 1	4	1	2	5
Specialist 2	3	2	4	4
Specialist 3	5	4	1	5
Specialist 4	2	3	0	4
Specialist 5	4	3	4	5
Specialist 6	3	2	2	4
Specialist 7	3	3	4	5
Specialist 8	2	1	3	4
Specialist 9	1	5	4	5
Specialist 10	4	1	2	5
Specialist 11	3	2	4	4
Specialist 12	2	4	4	5

Table 4. Economic Impact Assessment.

Specialist	Evaluation 1	Evaluation 2	Evaluation 3	Final Result \oplus_5
Specialist 1	4	3	2	5
Specialist 2	3	2	1	1
Specialist 3	5	4	3	5

Specialist	Evaluation 1	Evaluation 2	Evaluation 3	Final Result \oplus_5
Specialist 4	2	1	I	I
Specialist 5	4	5	4	5
Specialist 6	3	2	2	4
Specialist 7	I	3	4	I
Specialist 8	2	1	3	4
Specialist 9	1	I	4	I
Specialist 10	4	-1	2	5
Specialist 11	3	2	4	4
Specialist 12	2	4	I	I

Calculating the Mean for Each Variable

For each variable, the arithmetic mean is calculated as follows:

$$\bar{x}_{total,12} = \frac{\sum_{j=1}^{12} x_{total,i,j}}{12} \quad (4)$$

Table 5: Aggregation of the variables.

Variable	Average
1. Gender Equality	4.25
2. Human Rights	4.58
3. Economic Impact	2.6667+0.46I

In the next step the de-neutrosophication process is developed

Table 6: De-neutrosophication of variables.

Variable	Average
1. Gender Equality	4.25
2. Human Rights	4.58
3. Economic Impact	[0.3667, 4.9667]

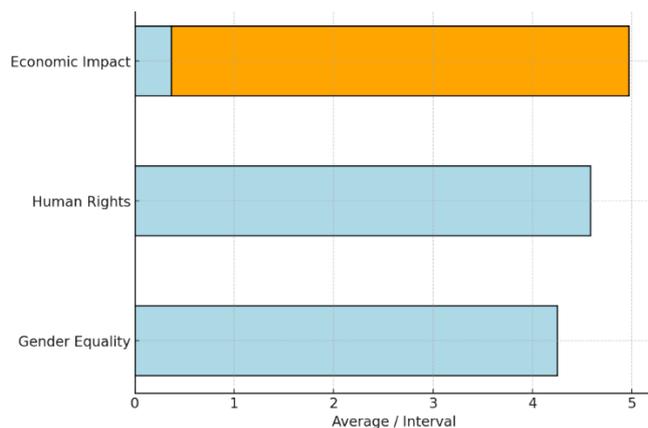


Figure 1: Horizontal Bar Chart of Variables with Interval Representation for Economic Impact.

While the values for "Gender Equality" (4.25) and "Human Rights" (4.58) are fixed, "Economic Impact" is represented as an interval ranging from 0.3667 to 4.9667. This indicates greater uncertainty or variability in the economic impact, suggesting it could fluctuate significantly compared to the more stable and predictable values of the other two variables. The interval highlights the wide range of possible outcomes for the economic impact, which could be very low or reach levels comparable to the other variables.

Conclusion

The conclusions of this paper indicate that the viability of a feminist foreign policy in Ecuador is a subject of considerable debate, with perceptions divided across specialists. While variables such as "Gender Equality" and "Human Rights" received stable, positive evaluations, the "Economic Impact" variable presented a notable degree of uncertainty. This is reflected in the range of possible outcomes, with values fluctuating between 0.3667 and 4.9667, highlighting both the potential for positive economic effects and the risk of instability. The use of neutrosophic sentiment analysis reveals that there are mixed feelings, with some individuals expressing support for a feminist foreign policy based on its potential to enhance international representation and gender equity, while others remain skeptical of its feasibility given Ecuador's political and social context.

For future work, it is recommended that more research be conducted to better understand the public and political reception of such policies. Expanding the study to include a broader range of stakeholders and conducting in-depth qualitative interviews could provide a more nuanced understanding of how feminist foreign policy might be adapted to Ecuador's unique realities. Additionally, further exploration of the economic implications is needed, particularly in the areas of trade and international cooperation, to assess the long-term sustainability and potential economic benefits of such a policy.

References

- [1] Scheyer, V., & Kumskova, M. (2019). Feminist foreign policy. *Journal of International Affairs*, 72(2), 57-76.
- [2] van Wyk, J. A. (2023). South Africa: A Growing Embrace of Feminist Foreign Policy?. *The Thinker*, 94(1), 64-76.
- [3] von Hlatky, S. (2021). *Women, peace, and security: feminist perspectives on international security* (Vol. 15). McGill-Queen's Press-MQUP.
- [4] Bustamante, F. (1992). Ecuador: Putting an end to ghosts of the past?. *Journal of Interamerican Studies and World Affairs*, 34(4), 195-224.
- [5] Rosén Sundström, M., & Elgström, O. (2020). Praise or critique? Sweden's feminist foreign policy in the eyes of its fellow EU members. *European Politics and Society*, 21(4), 418-433.
- [6] Smarandache, F. (2024). Super Hiper Función y Super Hiper Estructura y sus correspondientes Super Hiper Función Neutrosófica y Super Hiper Estructura Neutrosófica. *Neutrosophic Computing and Machine Learning*, 31, 353-359.
- [7] Mohamed, Z., M. Ismail, M. and Abd El-Gawad, A. (2023) "Sustainable Supplier Selection using Neutrosophic Multi-Criteria Decision Making Methodology", *Sustainable Machine Intelligence Journal*, 3,

- pp. (2):1–9.
- [8] Vázquez, M. Y. L., Cevallos, R. E. H., & Ricardo, J. E. (2021). Análisis de sentimientos: herramienta para estudiar datos cualitativos en la investigación jurídica. *Universidad Y Sociedad*, 13(S3), 262-266.
 - [9] Hinojosa, M., & Kittilson, M. C. (2020). *Seeing women, strengthening democracy: How women in politics foster connected citizens*. Oxford University Press, USA.
 - [10] Márquez-Carriel, D. C., Márquez-Sánchez, F., Oña-Garcés, L., & Vergara-Romero, A. (2024). Feminist Foreign Policy's Prospects in The Context of Global Cooperation. *Kurdish Studies*, 12(1), 3038-3050.
 - [11] Kandasamy, I., Vasantha, W. B., Obbineni, J. M., & Smarandache, F. (2020). Sentiment analysis of tweets using refined neutrosophic sets. *Computers in Industry*, 115, 103180.
 - [12] Kolchyna, O., Souza, T. T., Treleaven, P., & Aste, T. (2015). Twitter sentiment analysis: Lexicon method, machine learning method and their combination. *arXiv preprint arXiv:1507.00955*.
 - [13] Cruzaty, L. E. V., & Reynoso, A. M. R. (2024). New Neutrosophic Sentiment Analysis Method Based on NeuroAlgebra for the Evaluation of Ethics in Companies. *Neutrosophic Sets and Systems*, 70, 264-270.
 - [14] Zhang, C., & Luo, X. (1999). Isomorphic transformations of uncertainties for incorporating EMYCIN-style and PROSPECTOR-style systems into a distributed expert system. *Journal of Computer Science and Technology*, 14, 386-392.
 - [15] Reiter, J. E. (1983). A Review of the PROSPECTOR Project. *IEEE Database Eng. Bull.*, 6(4), 38-45.
 - [16] Batista-Hernández, N., González-Caballero, E., Valencia-Cruzaty, L. E., Ortega-Chávez, W., Huarac, C. F. P., and Chamorro, S. L. C. (2022). Theoretical study of the NeuroAlgebra generated by the combining function in Prospector and some pedagogical notes. In *Theory and Applications of NeuroAlgebras as Generalizations of Classical Algebras* (pp. 116-140). IGI Global.
 - [17] Awajan, I., Mohamad, M., & Al-Quran, A. (2021). Sentiment analysis technique and neutrosophic set theory for mining and ranking big data from online reviews. *IEEE Access*, 9, 47338-47353.
 - [18] Thelwall, M., Buckley, K., Paltoglou, G., Cai, D., & Kappas, A. (2010). Sentiment strength detection in short informal text. *Journal of the American society for information science and technology*, 61(12), 2544-2558.
 - [19] Salmerona, J. L., & Smarandache, F. (2010). Redesigning Decision Matrix Method with an indeterminacy-based inference process. *Multispace and Multistructure. Neutrosophic Transdisciplinarity (100 Collected Papers of Sciences)*, 4, 151.

Received: June 25, 2024. Accepted: August 18, 2024